Chapter 25

Trauma Overview

Unit Summary

After students complete this chapter and the related course work, they will have an understanding of the basic concepts of energy and its effect on the human body; the general injury patterns associated with different types of impacts, falls, and penetrating trauma; and the basic application of laws of physics on the assessment of trauma patients. Students will begin to demonstrate critical thinking in making predictions of injuries and adjusting index of suspicion based on the analysis of evidence gathered in scene size-up simulations. Students will also understand some common injury patterns to major body systems.

National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Trauma Overview

Pathophysiology, assessment, and management of the trauma patient

• Trauma scoring (p 924)

• Rapid transport and destination issues (pp 922–926)

• Transport mode (pp 924–926)

Multisystem Trauma

Recognition and management of

• Multisystem trauma (pp 918–919)

Pathophysiology, assessment, and management of

• Multisystem trauma (pp 918–919)

• Blast injuries (pp 915–918)

Knowledge Objectives

1. Define the terms *mechanism of injury* (MOI), *blunt trauma*, and *penetrating trauma*. (pp 901, 904)

2. Explain the relationship of the MOI to potential energy, kinetic energy, and work. (pp 901–902)

3. Provide examples of the MOI that would cause blunt and penetrating trauma to occur. (pp 904–915)

4. Describe the five types of motor vehicle crashes, the injury patterns associated with each one, and how each relates to the index of suspicion of life-threatening injuries. (pp 904–911)

5. Discuss the three specific factors to consider during assessment of a patient who has been injured in a fall, plus additional considerations for pediatric and geriatric patients. (pp 912–913)

6. Discuss the effects of high-, medium-, and low-velocity penetrating trauma on the body and how an understanding of each type helps EMTs form an index of suspicion about unseen life-threatening injuries. (pp 913–915)

7. Discuss primary, secondary, tertiary, and miscellaneous blast injuries and the anticipated damage each one will cause to the body. (pp 915–918)

8. Describe multisystem trauma and the special considerations that are required for patients who fit this category. (pp 918–919)

9. Explain the major components of trauma patient assessment; include considerations related to whether the MOI was significant or nonsignificant. (p 920)

10. Discuss the special assessment considerations related to a trauma patient who has injuries in each of the following areas: head, neck and throat, chest, and abdomen. (pp 920–922)

11. Provide a general overview of multisystem trauma patient management. (pp 922–924)

12. Explain trauma patient management in relation to scene time and transport selection. (pp 922–926)

13. List the criteria for the appropriate use of helicopter emergency medical services. (p 924)

14. Discuss the American College of Surgeons Committee on Trauma classification of trauma centers. (pp 922–924)

15. Explain the American College of Surgeon’s Committee on Trauma and the Centers for Disease Control and Prevention field triage decision scheme as it relates to making an appropriate destination selection for a trauma patient. (pp 922–925)

Skills Objectives

There are no skills objectives for this chapter.

Readings and Preparation

Review all instructional materials including ***Emergency Care and Transportation of the Sick and Injured***, **Twelfth Edition**, Chapter 25, and all related presentation support materials.

Support Materials

• Lecture PowerPoint presentation

• Case Study PowerPoint presentation

• Several copies of a human body diagram (anterior, posterior, and lateral, if possible) for distribution in activities designed to identify possible internal and external injuries based on the MOI.

Enhancements

• Direct students to visit Navigate.

• **Content connections:** Remind students that specific traumatic injuries will be discussed in detail in subsequent chapters. As students learn more about specific injuries and bleeding in the next two chapters, they will be able to more fully comprehend the value of the “Golden Hour.”

• **Cultural considerations**: In any interaction with a patient from another culture, students need to assure their own cultural beliefs do not interfere with appropriate assessment and treatment. All patients and their families deserve respect, and we must be mindful of the tendency to stereotype people unlike ourselves. The means by which we collect patient information may vary from culture to culture. In some cultures, women and children cannot be physically assessed without permission of the male head of household. In other cultures, trauma may be considered “predestined,” a factor of “karma,” or a “curse” rather than accidental. People from different cultures may use “folk medicine” that is unfamiliar to the EMT. People new to our country and our emergency medical system may be reluctant to be assessed. Students should keep an open mind when interacting with culturally diverse populations.

Teaching Tips

• Images are integral to the learning experience. This chapter on trauma presents many opportunities to use images to greatly enrich lessons by presenting the images for group interpretation, analysis, and argument.

• Remember to temper the visuals used. Keep in mind that overly graphic pictures of trauma patients may disrupt the class. Carefully placing well-chosen visuals within your lecture slides or for a separate activity should encourage active thought and discussion, not distraction. Plan a specific purpose for each visual selected. The links provided are good starting points for pictures and animations of trauma-related topics.

Unit Activities

**Writing activities:** Assign student pairs to research an injury that might occur in the absence of a piece of safety equipment. Have the team identify how this injury might be prevented. For example, have students research how a head injury might differ in severity with and without the proper use of a helmet. How does the helmet help change the forces transferred to the head? Similar assignments can be developed using seat belts, knee pads, shin guards, catcher’s masks, and other equipment as examples of how forces can be diverted from the body. Consider having students present or display their work as time allows.

**Student presentations:** Using the preceding assignment for ideas, invite students to bring a piece of safety equipment to class—perhaps from a sport or activity in which they participate. What injuries are avoided or minimized with this equipment? How are forces averted or transferred?

**Group activities:** Using a real crash picture or description, or creating fictitious scenarios, assign students in each group a “position” in a motor vehicle accident or other trauma-producing scenario. Each group has a particular accident in which they are involved—for example, a head-on collision traveling at 60 miles per hour. Assign one student as an unrestrained driver, one student as a restrained front seat passenger, one student as an unrestrained back seat passenger who is ejected, etc. Student groups must then use masking tape to identify potential areas of serious bodily injury based on the MOI.

**Visual thinking:** Assign students to create in pictures a demonstration of Newton’s three laws of motion.

Pre-Lecture

### You are the Provider

“You are the Provider” is a progressive case study that encourages critical thinking skills.

### Instructor Directions

**1.** Direct students to read the “You are the Provider” scenario found throughout Chapter 25.

**2.** You may wish to assign students to a partner or a group. Direct them to review the discussion questions at the end of the scenario and prepare a response to each question. Facilitate a class dialogue centered on the discussion questions and the Patient Care Report.

**3.** You may also use this as an individual activity and ask students to turn in their comments on a separate piece of paper.

Lecture

I. Introduction

A. For people younger than age 44 years, traumatic injuries are the leading cause of death in the United States.

1. Trauma emergencies occur as a result of physical forces applied to the body.

2. Medical emergencies occur from an illness or condition not caused by an outside force.

3. Evaluation of the MOI for the trauma patient will provide you with an index of suspicion for different types of serious and/or life-threatening underlying injuries.

a. Index of suspicion is your awareness and concern for potentially serious underlying and unseen injuries

II. Energy and Trauma

A. Traumatic injury occurs when the body’s tissues are exposed to energy levels beyond their tolerance.

1. Mechanism of injury describes the forces (or energy transmission) acting on the body that cause injury.

2. Three concepts of energy are typically associated with injury:

a. Potential energy

b. Kinetic energy

c. Energy of work

3. Energy can be neither created nor destroyed, but can only be converted or transformed.

B. Work is defined as force acting over a distance.

1. Forces that bend, pull, or compress tissues beyond their inherent limits result in the work that causes injury.

C. Kinetic energy is the energy of a moving object.

1. Reflects the relationship between the mass (weight) of the object and the velocity (speed) at which it is traveling

KE = ½ mass **×** velocity2

D. Potential energy is the product of mass (weight), force of gravity, and height

1. Mostly associated with the energy of falling objects

III. Mechanism of Injury Profiles

A. Different types of MOIs will produce many types of injuries.

1. Nonsignificant MOIs

a. Injury to an isolated body part

b. A fall without the loss of consciousness

2. Significant MOIs

a. Injury to more than one body system (multisystem trauma)

b. Falls from heights

c. Motor vehicle and motorcycle crashes

d. Car versus pedestrian or bicycle

e. Gunshot wounds

f. Stabbings

IV. Blunt and Penetrating Trauma

A. Traumatic injuries can be divided into two separate categories: blunt trauma and penetrating trauma.

1. Blunt trauma is the result of force to the body that causes injury without penetrating the soft tissues or internal organs and cavities.

2. Penetrating trauma causes injury by objects that primarily pierce and penetrate the surface of the body and cause damage to soft tissues, internal organs, and body cavities.

3. With either type it is important to consider unseen as well as visible, obvious injuries.

V. Blunt Trauma

A. Blunt trauma results from an object making contact with the body.

1. Motor vehicle crashes and falls are the most common MOIs.

2. Be alert to skin discoloration and pain as these may be the only signs of blunt trauma.

3. Maintain a high index of suspicion for hidden injuries.

B. Vehicular crashes

1. A crash typically consists of three collisions.

a. Car against another car, tree, or object

i. By assessing the vehicle that has crashed, you can often determine the MOI.

b. Passenger against the interior of the car

i. Kinetic energy produced by the passenger’s mass and velocity is converted into the work of stopping his or her body.

ii. Common passenger injuries include lower extremity fractures, rib fractures, and head trauma.

c. Passenger’s internal organs against the solid structures of the body

i. Internal injuries may not be as obvious as external injuries, but they are often the most life threatening.

d. Significant MOIs are suggested by the following findings:

i. Death of an occupant in the vehicle

ii. Severe deformity of the vehicle or intrusion into the vehicle

iii. Moderate intrusion from a lateral accident

iv. Severe damage from the rear

v. Crashes in which rotation is involved

vi. Ejection from the vehicle

2. Frontal crashes

a. Evaluate the supplemental restraint system.

i. Determine whether the passenger was restrained by a full and properly applied three-point restraint.

ii. Determine whether the airbag was deployed.

b. Seat belts and airbags are effective in preventing a second collision inside the motor vehicle.

i. Seat belts may decrease the severity of the third collision.

ii. Airbags decrease the severity of deceleration injuries and decrease injury to the chest, face, and head.

c. Despite airbags, suspect injuries to:

i. Extremities (resulting from the second collision)

ii. Internal organs (resulting from the third collision)

d. Children shorter than 4' 9″ should ride in the rear seat.

e. Remember that if the airbag did not inflate during the accident, it may deploy during extrication.

f. Remember that supplemental restraint systems can cause harm whether used properly or improperly.

i. Hip dislocations may result if seat belts are worn too low.

ii. Internal injuries can occur when the belt is worn too high.

iii. Lumbar spine fractures are also possible, particularly in children and older patients.

g. Look for contact points between the patient and the vehicle.

3. Rear-end crashes

a. Known to cause whiplash-type injuries, particularly in absence of an appropriately placed headrest

b. As the body is propelled forward, the head and neck are left behind.

c. Acceleration-type injury to the brain is possible.

d. Passengers in the backseat wearing only a lap belt may have a higher incidence of injuries to the thoracic and lumbar spine.

4. Lateral crashes

a. A common cause of death associated with motor vehicle crashes

b. A vehicle struck from the side is usually struck above its center of gravity.

i. Begins to rock away from the side of impact

ii. This results in the passenger sustaining a lateral whiplash injury.

c. If there is substantial intrusion into the passenger compartment, suspect:

i. Lateral chest and abdomen injuries on the side of the impact

ii. Possible fractures of the lower extremities, pelvis, and ribs

iii. Organ damage from the third collision

5. Rollover crashes

a. Large trucks and sport utility vehicles are prone to rollovers because of their high center of gravity.

b. Injuries depend on whether the passenger was restrained.

c. The most common life-threatening event in a rollover is ejection or partial ejection of the passenger from the vehicle.

d. Even when restrained, passengers can sustain severe injuries.

6. Rotational crashes

a. Rotational crashes (spins) are conceptually similar to rollovers.

b. The rotation of the vehicle as it spins provides opportunities for the vehicle to strike objects, such as utility poles.

C. Car versus pedestrian

1. Injuries are often graphic and apparent.

2. There can also be serious unseen injuries.

3. You should determine:

a. Speed of the vehicle

b. Whether the patient was thrown through the air and at what distance

c. Surface the patient landed on

d. Whether the patient was struck and pulled under the vehicle

4. Evaluate the vehicle that struck the patient for structural damage.

5. ALS backup should be summoned for any patients who have or are thought to have sustained a significant MOI.

D. Car versus bicycle

1. Evaluate the MOI in much the same manner as car-versus-pedestrian crashes.

a. Evaluate the damage to, and position of, the bicycle.

b. If the patient was wearing a helmet, inspect it for damage.

2. Presume that the patient has sustained an injury to the spinal column, or spinal cord.

3. Spinal stabilization must be initiated and maintained during the encounter.

E. Car versus motorcycle

1. Protection is from:

a. Helmet

i. Does not protect against severe cervical injury

b. Leather or abrasion-resistant clothing

i. Will protect against road abrasion not against blunt trauma from secondary impacts

c. Boots

2. When assessing the scene of a motorcycle crash, look for:

a. Deformity of the motorcycle

b. Side of most damage

c. Distance of skid in the road

d. Extent and location of deformity in the helmet

3. There are four types of motorcycle impacts.

a. Head-on crash

i. The motorcycle strikes another object and stops its forward motion while the rider continues his or her forward motion until stopped by an outside force.

b. Angular crash

i. The motorcycle strikes an object or another vehicle at an angle so that the rider sustains direct crushing injuries to the lower extremity between the object and the motorcycle.

c. Ejection

i. The rider will travel at high speed until stopped by a stationary object, another vehicle, or road drag.

ii. Severe abrasion injuries down to bone can occur with drag.

d. Controlled crash

i. A technique used to separate the rider from the body of the motorcycle and the object to be hit is referred to as laying the bike down.

F. Falls

1. The injury potential of a fall is related to the height from which the patient fell.

a. The greater the height of the fall, the greater the potential for injury.

b. A fall from more than 20 ft (6 m) is considered significant.

2. Internal injuries pose the greatest threat to life.

3. Patients who fall and land on their feet may have less severe internal injuries because their legs may have absorbed much of the energy of the fall.

a. They may have very serious injuries to the lower extremities, pelvis, and spine.

4. Take into account:

a. The height of the fall

b. The type of surface struck

c. The part of the body that hit first, followed by the path of energy displacement

VI. Penetrating Trauma

A. Penetrating trauma is the second-leading cause of trauma death in the United States after blunt trauma.

1. Low-energy penetrating trauma may be caused:

a. Accidentally by impalement

b. Intentionally by a knife, ice pick, or other weapon

2. With low-energy penetrations, injuries are caused by the sharp edges of the object moving through the body and are, therefore, close to the object’s path.

3. Knives may have been deliberately moved around internally, causing more damage than the external wound suggests.

B. In medium- and high-velocity (speed) penetrating trauma, the path of the projectile (usually a bullet) may not be easy to predict.

1. The bullet may flatten out, tumble, or ricochet within the body before exiting.

2. The path the projectile takes is its trajectory.

3. Fragmentation will increase damage.

4. Cavitation can result in serious injury to internal organs distant to the actual path of the bullet.

a. Temporary cavitation injury results from a stretching of the tissues that occurs with pressure changes.

b. Permanent cavitation injury results closer to the bullet path and remains after the projectile has passed through the tissue.

C. The relationship between distance and the severity of injury varies depending on the type of weapon involved.

1. Air resistance, or drag, slows the projectile, decreasing the depth of penetration and energy of the projectile, and thus reducing damage to the tissues.

2. The area that is damaged by medium- and high-velocity projectiles is typically many times larger than the diameter of the projectile itself.

a. This is one reason that exit wounds are often many times larger than entrance wounds.

3. The energy available for a bullet to cause damage is more a function of its speed than its mass.

4. An important factor for the seriousness of a gunshot wound is the type of tissue through which the projectile passes.

VII. Blast Injuries

A. Blast injuries are seen in civilian practice in mines, shipyards, chemical plants, and in association with terrorist activities.

1. People who are injured in explosions may be injured by four different mechanisms.

a. Primary blast injuries

i. These are due entirely to the blast itself.

ii. Damage to the body is caused by the pressure wave generated by the explosion.

b. Secondary blast injuries

i. Damage to the body results from being struck by flying debris.

c. Tertiary blast injuries

i. The victim is hurled by the force of the explosion against a stationary object.

d. Quaternary (miscellaneous) blast injuries

i. Burns from hot gases or fires started by the blast

ii. Respiratory injury from inhaling toxic gases

iii. Crush injury from the collapse of buildings

iv. Suffocation, poisoning, other medical emergencies

v. Contamination of wounds from environmental, chemical, or toxic substances

2. Most patients who survive an explosion will have some combination of the four types of injury.

B. Tissues at risk

1. Organs that contain air, such as the middle ear, lung, and gastrointestinal tract, are the most susceptible to pressure changes.

2. The ear is most sensitive to blast injuries.

3. Pulmonary blast injuries are defined as pulmonary trauma that results from short-range exposure to the detonation of explosives.

a. Primary blast injury is often characterized by a lack of external visible injuries.

4. Pneumothorax is a common injury and may require decompression.

5. One of the most concerning pulmonary blast injuries is arterial air embolism, which occurs on alveolar disruption with subsequent air embolization into the pulmonary vasculature.

a. Can produce:

i. Disturbances in vision

ii. Changes in behavior

iii. Changes in state of consciousness

iv. Variety of other neurologic signs

6. Solid organs are relatively protected from shock wave injury but may be injured by secondary missiles or a hurled body.

7. Neurologic injuries and head trauma are the most common causes of death from blast injuries.

8. Extremity injures, including traumatic amputations, are common.

VIII. Multisystem Trauma

A. Multisystem trauma involves more than one body system.

1. Head and spinal trauma

2. Chest and abdominal trauma

3. Chest and multiple extremity trauma

4. Alert medical control and transport rapidly.

5. Multisystem trauma patients have a high level of morbidity and mortality.

B. Golden principles of prehospital trauma care

1. Your main priority is to ensure:

a. Your safety

b. Safety of your crew

c. Safety of the patient

2. Determine the need for additional personnel or equipment.

3. Evaluate the MOI.

4. Identify and manage life threats.

5. Then focus on patient care.

a. Hemorrhage control has the highest priority.

b. Assess and manage the airway, including ventilatory support and high-flow oxygen, while maintaining appropriate spinal restriction is the second priority.

c. Ensure that other shock therapy is completed.

d. Protect the spine and proceed with spinal immobilization if indicated.

6. Transport the patient immediately to the appropriate facility.

7. In most patients with multisystem trauma, definitive care requires surgical intervention.

a. On-scene time should be limited to 10 minutes or less.

8. During transport, obtain a SAMPLE history and complete a secondary assessment.

9. Consider ALS intercept and/or air medical transportation.

IX. Patient Assessment

A. When you are caring for a patient who has experienced a significant MOI and the patient is considered to be in serious or critical condition, you should rapidly perform a physical examination.

1. With a patient who has experienced a nonsignificant MOI, focus on the chief complaint while assessing the patient as a whole.

B. Injuries to the head

1. Disability and unseen injury to the brain may occur.

2. Bleeding or swelling inside the skull is often life threatening.

3. Include frequent neurologic examinations in your assessment.

4. Some patients will not have obvious signs or symptoms until minutes or hours after the injury has occurred.

C. Injuries to the neck and throat

1. Airway problems may result that could quickly become a serious life threat.

2. Your assessment must include frequent physical examinations looking for DCAP-BTLS in the neck region.

a. Assess for jugular vein distention and tracheal deviation.

3. Swelling may prevent blood flow to the brain and cause injury to the central nervous system.

4. A penetrating injury may result in an air embolism.

5. A crushing injury to the upper part of the neck may cause the cartilages of the upper airway and larynx to fracture.

D. Injuries to the chest

1. The chest contains the heart, lungs, and large blood vessels.

2. Many life-threatening injuries may occur.

a. Broken ribs may hinder breathing.

b. Bruising may occur to the heart and cause an irregular heartbeat.

c. Large vessels of the heart may be torn inside the chest causing severe internal bleeding.

d. Air may collect between the lung tissue and the chest wall, known as a pneumothorax.

e. The collection of blood in the chest is called a hemothorax.

3. A penetration or perforation of the integrity of the chest is called an open chest wound.

a. If left untreated, shock and/or death will result.

b. It is imperative that you assess the chest region every 5 minutes.

c. Assessment should include DCAP-BTLS, lung sounds, and chest rise and fall.

E. Injuries to the abdomen

1. The abdomen contains vital organs that require a very high amount of blood flow to perform the functions necessary for life.

2. Solid organs may tear, lacerate, or fracture, which can cause serious bleeding into the abdomen.

a. Solid organs include the liver, spleen, pancreas, and kidneys.

3. Hollow organs may rupture and leak toxic digestive chemicals causing the possibility of a life-threatening infection.

a. Hollow organs include the stomach, large and small intestines, and urinary bladder.

4. The rupture of large blood vessels can cause serious unseen bleeding.

X. Management: Transport and Destination

A. Scene time

1. Survival of critically injured trauma patients is time dependent.

2. On-scene time for critically injured patients should be less than 10 minutes—the platinum 10.

3. The following criteria will help identify a critically injured patient:

a. Dangerous MOI

b. Decreased level of consciousness

c. Threats to airway, breathing, or circulation.

4. Patients who are very young or old or have chronic illnesses should also be considered to be high risk.

B. Destination selection

1. Trauma centers are classified into Levels I through IV, with Level I having the most resources, followed by Levels II, III, and IV, respectively.

a. Level I facility provides every aspect of trauma care.

b. Level II facility provides initial definitive care.

c. Level III facility provides assessment, resuscitation, emergency care, and stabilization.

d. Level IV facility provides advanced trauma life support.

2. The Association of Air Medical Services (AAMS) and MedEvac Foundation International identify the following criteria for appropriate use of emergency air medical services for trauma patients:

a. There is an extended period required to access or extricate a remote or trapped patient.

b. The distance to the trauma center is more than 20 to 25 miles.

c. The patient needs ALS care and there is no ALS-level ground ambulance service available within a reasonable time frame.

d. Traffic conditions or hospital availability make it unlikely that the patient will get to a trauma center via ground ambulance within the ideal time frame.

e. There are multiple trauma patients who will overwhelm resources at the nearby trauma center(s).

f. EMS systems require bringing a patient to the nearest hospital rather than bypassing facilities to go directly to a trauma center. This may add delay to receiving definitive surgical care.

g. There is a mass-casualty incident.

3. Trauma centers are categorized as either adult or pediatric trauma centers.

4. In 2011, the ACS-COT and the CDC published an updated field triage decision scheme to identify patients who would benefit from transport to a trauma center.

C. Type of transport

1. Modes of transport ultimately come in one of two categories:

a. Ground EMS units are staffed by EMTs and paramedics.

b. Air EMS units or critical care transport units are staffed by critical care nurses and paramedics.

D. Special considerations

1. Remain calm.

2. Complete an organized assessment.

3. Correct life-threatening injuries.

4. Do no harm.

5. Never hesitate to contact ALS backup or medical control for guidance.

Post-Lecture

## Assessment in Action

A. Assessment in Action is available in the Navigate course.